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## CLAIMS

What is claimed is:

- 5 1. An insulating film comprising a carbon containing silicon oxide (SiOCH) film which has Si-CH<sub>2</sub> bond in the carbon containing silicon oxide film.
- 10 2. An insulating film as set forth in claim 1, wherein the proportion of Si-CH<sub>2</sub> bond (1360cm<sup>-1</sup>) to Si-CH<sub>3</sub> bond (1270cm<sup>-1</sup>) in the insulating film is in a range from 0.03 to 0.05 measured as a peak height ratio of FTIR spectrum.
- 15 3. An insulating film as set forth in claim 1, wherein the relative dielectric constant of the insulating film is equal to or lower than 3.1.
- 20 4. An insulating film as set forth in claim 1, wherein the carbon containing silicon oxide (SiOCH) film is formed by using plasma enhanced CVD process.
- 25 5. An insulating film as set forth in claim 1, wherein the carbon containing silicon oxide (SiOCH) film comprises methylsilsesquioxane.
- 30 6. A semiconductor device having an interlayer insulating film formed on or over a semiconductor substrate and a metal wiring conductor which is formed by filling a wiring trench formed in the interlayer insulating film with Cu containing metal via a barrier metal, wherein the interlayer insulating film includes

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the insulating film comprising a carbon containing silicon oxide (SiOCH) film which has Si-CH<sub>2</sub> bond in the carbon containing silicon oxide film.

- 5 7. A semiconductor device as set forth in claim 6, wherein the proportion of Si-CH<sub>2</sub> bond (1360cm<sup>-1</sup>) to Si-CH<sub>3</sub> bond (1270cm<sup>-1</sup>) in the insulating film is in a range from 0.03 to 0.05 measured as a peak height ratio of FTIR spectrum.
- 10 8. A semiconductor device as set forth in claim 6, wherein the relative dielectric constant of the insulating film is equal to or lower than 3.1.
- 15 9. A semiconductor device as set forth in claim 6, wherein the carbon containing silicon oxide (SiOCH) film is formed by using plasma enhanced CVD process.
- 20 10. A semiconductor device as set forth in claim 6, wherein the carbon containing silicon oxide (SiOCH) film comprises methylsilsequioxane.
- 25 11. A semiconductor device as set forth in claim 6, wherein, as a portion of the interlayer insulating film, an SiO<sub>2</sub> film is formed on the upper layer portion of the insulating film.
- 30 12. A semiconductor device as set forth in claim 6, wherein, as a portion of the interlayer insulating film, an insulating film for preventing metal diffusion is formed on the lower layer portion of the insulating film.

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13. A semiconductor device as set forth in claim 6, wherein the Cu containing metal contains, in addition to Cu, at least one of Si, Al, Ag, W, Mg, Be, Zn, Pd, Cd, Au, Hg, Pt, Zr, Ti, Sn, Ni and Fe.

14. A semiconductor device having an interlayer insulating film formed on or over a semiconductor substrate, an opening which is formed in the interlayer insulating film and which reaches a lower layer metal wiring conductor, and a metal plug which is formed by filling the opening with Cu containing metal via a barrier metal, wherein the interlayer insulating film includes the insulating film comprising a carbon containing silicon oxide (SiOCH) film which has Si-CH<sub>2</sub> bond in the carbon containing silicon oxide film.

15. A semiconductor device as set forth in claim 14, wherein the proportion of Si-CH<sub>2</sub> bond (1360cm<sup>-1</sup>) to Si-CH<sub>3</sub> bond (1270cm<sup>-1</sup>) in the insulating film is in a range from 0.03 to 0.05 measured as a peak height ratio of FTIR spectrum.

16. A semiconductor device as set forth in claim 14, wherein the relative dielectric constant of the insulating film is equal to or lower than 3.1.

17. A semiconductor device as set forth in claim 14, wherein the carbon containing silicon oxide (SiOCH) film is formed by using plasma enhanced CVD process.

18. A semiconductor device as set forth in claim 14, wherein the carbon containing silicon oxide (SiOCH) film comprises

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methyilsilsesquioxane.

19. A semiconductor device as set forth in claim 14, wherein,  
as a portion of the interlayer insulating film, an SiO<sub>2</sub> film is  
5 formed on the upper layer portion of the insulating film.

20. A semiconductor device as set forth in claim 14, wherein,  
as a portion of the interlayer insulating film, an insulating film  
for preventing metal diffusion is formed on the lower layer  
10 portion of the insulating film.

21. A semiconductor device as set forth in claim 14, wherein  
the Cu containing metal contains, in addition to Cu, at least one  
of Si, Al, Ag, W, Mg, Be, Zn, Pd, Cd, Au, Hg, Pt, Zr, Ti, Sn, Ni  
15 and Fe.

22. A semiconductor device having an interlayer insulating  
film formed on or over a semiconductor substrate, a wiring  
trench formed in the interlayer insulating film, an opening  
20 which is formed in the interlayer insulating film and which  
reaches a lower layer metal wiring conductor from the bottom  
portion of the wiring trench, and a metal wiring conductor and  
metal plug which are formed by filling the wiring trench and  
the opening with Cu containing metal via a barrier metal.  
25 wherein the interlayer insulating film includes the insulating  
film comprising a carbon containing silicon oxide (SiOCH) film  
which has Si-CH<sub>2</sub> bond in the carbon containing silicon oxide  
film.

30 23. A semiconductor device as set forth in claim 22, wherein

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the proportion of Si-CH<sub>2</sub> bond (1360cm<sup>-1</sup>) to Si-CH<sub>3</sub> bond (1270cm<sup>-1</sup>) in the insulating film is in a range from 0.03 to 0.05 measured as a peak height ratio of FTIR spectrum.

- 5 24. A semiconductor device as set forth in claim 22, wherein the relative dielectric constant of the insulating film is equal to or lower than 3.1.
- 10 25. A semiconductor device as set forth in claim 22, wherein the carbon containing silicon oxide (SiOCH) film is formed by using plasma enhanced CVD process.
- 15 26. A semiconductor device as set forth in claim 22, wherein the carbon containing silicon oxide (SiOCH) film comprises methylsilsesquioxane.
- 20 27. A semiconductor device as set forth in claim 22, wherein, as a portion of the interlayer insulating film, an SiO<sub>2</sub> film is formed on the upper layer portion of the insulating film.
- 25 28. A semiconductor device as set forth in claim 22, wherein, as a portion of the interlayer insulating film, an insulating film for preventing metal diffusion is formed on the lower layer portion of the insulating film.
29. A semiconductor device as set forth in claim 22, wherein the Cu containing metal contains, in addition to Cu, at least one of Si, Al, Ag, W, Mg, Be, Zn, Pd, Cd, Au, Hg, Pt, Zr, Ti, Sn, Ni and Fe.

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